

IMPROVEMENTS IN ASSEMBLING PACKAGING

The present invention relates to improvements in assembling packaging, especially packaging which incorporates a tape, such as a tear tape, to assist in the opening of a package.

In known systems, a sheet of packaging material which will form a plurality of packages is printed, before being cut into the requisite sized packages. If a tear tape is to be included in the finished package, this is usually applied after the printing step, but before the sheet is cut. Tear tape is usually supplied on self-wound reels, wherein one side of the tape is coated with pressure-sensitive adhesive, and the other side is coated with a release agent, such as silicon. Such a tape is disclosed in the applicant's own EP 0 121 371.

Alternatively, if the tape is not self-wound, a release paper may be provided to prevent the tape from adhering to itself too strongly. Alternatively, an adhesive, such as hot melt adhesive, can be applied to one side of the tape, by a hot shoe, or similar device as a step of the application process.

The present invention is mainly concerned with the application of self-wound tear tape to packaging, where one side of the tape is coated with release agent and the other is coated with pressure-sensitive adhesive. This type of tape has advantages over the hot melt adhesive type in that: the tape can be applied more quickly, there is less likelihood of the adhesive contaminating other parts of the machinery, and no adhesive seeps out from under the tape after its application. Such seepage could, for example, cause problems when different packaging portions to which tapes are applied are stacked on top of each other, especially when the adhesive is still warm.

In known systems where tear tape is applied to packaging, tape is fed into the printing machine from a tape reel which may be motorised, depending upon the size and type of reel. The tape is then applied to the packaging as the packaging passes through the machine. When the reel of tape is empty, the machine must be stopped temporarily so that the reel can be changed. Obviously, this decreases productivity, not only because the printing has temporarily ceased, but also because upon restarting of the machine the distinct printing stages must again be brought into precise registration before the printing may be continued at normal speed.

EP 0358 477 discloses a toggle for attaching the trailing edge of a tape currently in use to the leading end of a reserve tape. The tape in use is supplied with a pin, which is disposed transversely to the axial extent of the tape. The reserve tape is provided with a loop, through which the tape in use (i.e. current tape) passes. When the pin attached to the tape in use contacts the loop, the reserve tape will be drawn into the machine. The portion of packaging incorporating this toggle will subsequently have to be located manually and discarded. This document discusses the fact that this toggle may cause the reserve tape to be fed into the machine upside down and that this could be a problem for tapes with one adhesive side. To address this problem the document discusses including a tail segment, where the portion of the tape in use that is attached to the reel is loosely attached (for example, with masking tape) to the portion of the in use tape having the pin. However, this arrangement involves complicated preparation of the tapes and is therefore undesirable.

US 4,572,460 discloses a similar system in which the tape in use is provided with an aperture, and the reserve tape is supplied with a "mushroom-like" tab. There is no

mention of any modification that would make this apparatus suitable for use with adhesive tape.

It would be advantageous to be able to supply tape continuously from a plurality of rolls of tape sequentially, without having to prepare the tapes, or having to attach anything thereto as with the prior art.

One aspect of the present invention provides a method of splicing tapes, having an adhesive coating, the method comprising the steps of:

driving a first tape supplied from a first tape supply reel past a splicing area, the splicing area including at least two rollers movable between a closed position in which contact is made with tape in the splicing area, and an open position in which contact is not made with any tape in the splicing area;

introducing a second tape from a second tape supply reel into the splicing area when the rollers are in the open position; and

pressing the first and second tapes together with the rollers, to cause the first and second tapes to adhere together, one on top of the other.

Preferably the method includes the steps of monitoring the amount of tape remaining on the first reel and moving the rollers in the splicing area into the closed position when the amount of tape remaining on the first reel falls to a predetermined level.

At least one of the first or second tapes should be coated with adhesive on one side.

Preferably the method further includes the step of cutting the first tape after the tapes have been joined.

Preferably the method further includes the step of moving the rollers to the open position.

The step of monitoring the amount of tape remaining on the first reel may be automated.

The step of moving the rollers to the closed position when the amount of tape remaining on the first reel falls to a predetermined level may be automated, and may be based on the automatic monitoring of the amount of tape remaining on the first reel.

The step of cutting the first tape may be automatic, and may be performed when a predetermined time has elapsed with the rollers in the closed position.

The step of monitoring the amount of tape on the first reel may comprise the steps of:

- resting circumferentially on the reel an arm, one end of which is pivotally mounted on a rotary potentiometer, so that as tape is dispensed from the reel, and its diameter reduces, the arm is displaced pivotally;

- monitoring the change in potential difference across the potentiometer;

- using the said change in potential difference across the potentiometer to determine the amount of tape remaining on the reel.

Alternatively, the step of monitoring the amount of tape on the first reel may comprise the steps of:

- resting circumferentially on the reel an arm, provided with a metal target, so that as tape is dispensed from the reel, and its diameter reduces, the arm is displaced;

- providing an inductive sensor in the proximity of the metal target;

- monitoring the load on the inductive sensor;

- using the load on the inductive sensor to determine the amount of tape remaining on the reel.

According to another aspect of the present invention there is provided an apparatus for supplying a continuous

length of adhesive tape from reels carrying discrete amounts of adhesive tape, the apparatus comprising:

a splicing unit, including a tape path for conveying tape, and at least two rollers, being movable between an open position in which the rollers do not come into contact with the tape path and a closed position in which the rollers contact the tape path to join together tapes from different reels in use.

There may be further provided first and second tape dispensers, for holding first and second reels of adhesive tape, respectively, wherein the splicing unit further includes at least one reserve tape retaining means, for retaining a leading edge of a tape from one of the first or second reels as a reserve reel.

The other of the first or second reels, as a currently-supplying reel, may be provided with an automatic monitoring system for monitoring the amount of tape held on the reel. The monitoring system may be connected to a control unit, which is arranged to move the rollers from the open position to the closed position when a signal from the monitoring system indicates that the amount of tape held on the currently-supplying reel has reached a predetermined low level.

The control unit may also control the reserve tape retainer, for allowing a tape held thereon to become released therefrom when the rollers move into the closed position.

The control unit may actuate a cutting mechanism, for cutting a tape from a spent reel when the rollers are in the closed position. The cutting may be activated a predetermined time after the rollers have been moved into the closed position.

The control unit may return the rollers into the open position a predetermined time after they moved into the closed position.

The monitoring unit may comprise:

an arm pivotally mounted on a portion of casing, for positioning circumferentially on a reel of tape, and a rotary potentiometer attached pivotally to one end of the arm, so that as the arm falls, the potential difference across the potentiometer will vary according to the position of the arm, for determining the amount of tape remaining on a reel.

Alternatively, the monitoring unit may comprise:

an arm having a metal target, pivotally mounted on a portion of casing, for positioning circumferentially on a reel of tape, and in the proximity of an inductive sensor, so that as the arm falls, a different loading on the inductive sensor is produced, for determining the amount of tape remaining on a reel.

A DC output may be produced by the monitoring unit which may then be input into a control unit.

According to another aspect of the invention there is provided tape splicing apparatus for splicing together tapes from different tape supply reels, the apparatus comprising:

a splicing station, having a first tape input path along which tape is arranged to pass from a first tape supply reel to a common tape output, and a second tape input path along which tape is arranged to pass from a second tape supply reel to the common tape output, wherein the splicing station has at least a pair of nip rollers movable between a first, open configuration in which the rollers are spaced apart, and a second, closed configuration, in which the rollers come together to urge the tape portions from the first and second input paths into contact, one on top of the other;

wherein one of the first and second tape supply reels is arranged as a current reel and the other reel is arranged as a standby reel;

wherein the apparatus comprises means arranged in use to determine the quantity of tape remaining on the

current reel and/or the estimated time remaining before the tape supply on the current reel is exhausted;

wherein, based upon said determination, the apparatus is arranged to move the nip rollers from the first position to the second position to cause the tapes to adhere to one another;

and wherein, the apparatus further provides cutting means, arranged to cut the tape from the current reel thereby to replace the current reel with the standby reel.

The present invention may include any combination of the features and/or limitations referred to herein, except such features as are mutually exclusive.

Preferred embodiments of the present invention will now be described with reference to the following drawings, in which:

Fig. 1 shows tape from a dispensing unit being fed to packaging material in accordance with an embodiment of the present invention;

Fig. 2 shows the tape dispensing unit of Fig. 1;

Fig. 3 shows the tape splicing portion of the tape dispensing unit of Fig. 2;

Fig. 4 shows a tape loaded on the tape dispensing unit;

Fig. 5 shows a tape in use on the tape dispensing unit;

Fig. 6 shows two tapes being spliced together;

Fig. 7 shows the join between two tapes;

Fig. 8 shows a portion of the tape-splicing unit in more detail;

Fig. 9 shows part of an empty reel detection system;

Fig. 10 shows part of another detection system;

Fig. 11 shows a schematic diagram of a control system.

Turning to Fig. 1, this shows generally at 10 a tape dispensing unit in accordance with an embodiment of the present invention, feeding tear tapes 12, 13, to a continuous portion of packaging material 14. The portion of packaging may be, for example, in a printing machine, so that commercial graphics and other information may be printed thereon. The dispensing unit may be located outside the printing machine. The tear tape is applied to the packaging portions so that consumers may easily open the assembled packages. In this example, two tapes, each of which is a self-wound pressure sensitive tear-tape, having one surface coated in pressure-sensitive adhesive and having the other, opposed surface coated in a silicon release coating, are applied to the packaging portion 14. This portion will subsequently be cut into individual packaging portions, each of which will eventually form a package. In practice a larger number of tapes can be applied in this way (for example 6 tapes). Tape is applied to the packaging from a reel. A reserve reel also holding tape is provided. When the end of the tape on the reel in use is reached the tape dispensing unit splices together the end of the tape in use with the beginning of the reserve reel, so that tape is fed continuously to the packaging material.

Fig. 2 shows the dispensing unit 10 of Fig. 1 in more detail, where tapes 12, 13 are being dispensed from the machine 10. For each of tapes 12, 13 there are two servo-assisted motor-driven dispenser reels 16a, 16b. The tape from these reels is conveyed to a splice unit 18 via accumulators 20. The splice unit ensures that a continuous supply of tape is dispensed from the dispensing unit 10, even when the supply from one of the reels 16a, 16b becomes exhausted. A control cabinet 22 is disposed on the side of the dispensing unit 10. The function of this will be described later.

Fig. 3 shows the splice unit 18 of Fig. 2 in more detail. Two tapes 12a and 12b are fed into the splice unit. In this example, the upper tape 12a is in use - i.e. it is currently being applied to the packaging (not shown). It is fed through the splice unit, and onto an accumulator. It is then fed out of the machine and applied to packaging, as shown in Fig. 1. The lower tape 12b is in the standby position. It is manually fed into the splicing unit by an operative, and the leading edge is held in place by a vacuum shoe 26b.

Fig. 4 shows a perspective view of the splicing unit with the tape 12b in the standby position, resting on the vacuum shoe 26b. The tape is prevented from being accidentally drawn back onto its supply reel by a one-way tape-clamp roller 28b and a roller 30b.

Fig. 5 shows a perspective view of the splicing unit with the upper tape 12a in use. The tape is guided by a roller 30a, and passes over a tape guide roller 32. The splicing unit has upper and lower parts 18a, 18b, carrying the upper and lower tapes 12a, 12b respectively. When the control unit 22 determines that the supply of the upper tape 12a has almost finished, the upper and lower portions of the splicing machine 18a, 18b are pressed together.

Fig. 6 shows the splicing unit when the upper and lower portions are brought together. A pneumatic actuator 33a, 33b is connected to each of the upper and lower section of the splicing machine to enable the two sections to be pressed together. The upper tape, currently in use 12a is pressed against the lower, reserve tape 12b by nip rollers 34a, 34b. The upper and lower nip rollers are provided with appropriate coatings to prevent them from sticking to the surfaces of the tapes with which they are in contact. The calculated force at the point of joining the two tapes together between the nip rollers is in the region of 175N. The

pressure sensitive adhesive coating of one tape adheres sufficiently well to the release coating of the other tape and over a sufficient length, such that one tape may pull the other.

After a suitable time has elapsed the upper tape 12a is cut against an anvil 36, by a cutter 38a. The leading edge of the lower tape is now attached to the trailing edge of the upper tape 12a and the former is drawn out of the splicing machine. The reel dispensers are motorised since the new reel will have a large amount of inertia. This reduces the risk of the tape breaking under the tension caused by acceleration. Furthermore, each tape runs from its dispenser to an accumulator. The accumulator has the effect of accelerating the tape slightly before splicing occurs, and allows the length of the tape path to decrease slightly after splicing has occurred, to reduce the effect of the tension caused by the acceleration.

After the spent upper tape 12a is cut, the nip rollers are drawn apart again after a suitable time to ensure that the tapes are properly adhered together. The lower tape 12b is now fed onto the packaging material. Then, a new reel of tape will be fitted in place of the spent reel, and the leading edge of this tape drawn out and placed on the vacuum shoe 26a. A corresponding process will be carried out when the lower tape 12b currently in use runs out. Accordingly, this process can be carried out indefinitely without stopping the machine, which would lead to costly "down-time" and reduce productivity.

Fig. 7 shows the two portions of the upper and lower tape 12a, 12b spliced together. The top diagram shows how the tapes are spliced together in the case of the splicing discussed in relation to Fig. 6 (i.e. where the upper tape 12a is replaced with the lower tape 12b). The old upper tape 12a has pressure sensitive adhesive 40

on its underside. This sticks to the non-adhesive side of the new lower tape 12b. Part of the packaging material will have a portion of tape in which there is a double thickness of tape, as shown in Fig. 7. However, this portion of tape will not be able to function as a tear tape because the adhesive bond between the two portions of tape is not strong enough to adhere the portions together when the tape is torn through packaging. The average breaking strength of a splice of two self-windable tapes with an overlap of 70mm is 4.2 kg. This weak bonding is necessarily the case, since in the case of self-wound tape one side of the tape is coated with a release coat which prevents the surface of the tape coated with pressure sensitive adhesive from sticking to its adjacent winding too strongly. Accordingly, the portion of the packaging which carries this double thickness of tape must be located and discarded. The lower diagram in Fig. 7 shows the positioning of the tapes if the lower tape 12b is in use, and a new upper tape 12a is to be spliced thereon. In either case the adhesive 40 on the underside of the upper tape 12a adheres the tapes together.

Fig. 8 shows a perspective view of one of the portions of the splicing machine 18b in more detail. The tapes are clamped in the reserve position by a clamp roller 28b and a tape guide roller 30b. These rollers are positioned by a pneumatic cylinder 42. The cutter 38b, which is arranged to cut an almost spent tape which has been spliced, is a rotary cutter. The cutter and the nip rollers 34b are moved by a pneumatic actuator 33b. This allows the nip rollers of the upper and lower portions of the splicing unit 18a, 18b to be moved together and apart, to perform the splicing action. The vacuum shoe, or guide block 26b has a channel, with small holes disposed therein. The vacuum shoe is held at a

slightly negative pressure; hence the holes will draw the tape to the shoe and hold it thereon.

Fig. 9 shows a detection system mounted on the wall of the dispensing unit. This detection system detects the radius of a reel of tape 44 so that the splicing unit can be activated when the amount of tape on the reel in use falls to a low level. An arm 46 is pivotally mounted on the case of the detection unit. This arm rests on the circumference of the reel. A metal target 48 is housed on the arm 46. As the tape on the reel is used, the diameter of the reel decreases and the arm falls. An inductive sensor 50 is located in the proximity of the arm, and when the arm falls the metal target moves near the inductive sensor 50. When the inductive sensor senses that the arm has fallen by a certain amount, a signal can be sent to order the splicing unit to activate, hence splicing the new, reserve tape and preventing the supply of tape from running out. An accumulator arm 20, balanced by an adjustable weight 52 can also be seen in this diagram.

Fig. 10 shows another, alternative detection system. This system also involves an arm pivotally mounted on the case of the detection unit. In this case the arm is connected to a potentiometer 54. The position of the arm is converted to a DC output by the potentiometer, between 0 and 10 V. This input can be used to derive information about the amount of tape left on the reel, and may detect as little as one tape thickness remaining on the reel. Similarly to the case above, if the amount of tape left on the reel is sufficiently small the controller can instruct the splicing unit to splice the new, reserve tape. Fig. 10 also shows an additional potentiometer 56. This can be used to control the speed of the motor 58 which drives the main shaft onto which the reel of tape is mounted. As mentioned above, a full reel of tape has a relatively

large amount of inertia. Accordingly, a relatively large force must be applied to the tape to accelerate the reel to the required speed. Therefore there is a danger of the tape breaking if it is subjected to a large acceleration. In order to reduce the momentary force on the tape, the tape dispenser is provided with a motorised spool 60. As mentioned earlier the tape may also be conveyed via an accumulator, which can provide a variable tape path, which shortens when the tape is subject to higher tension.

Fig. 10 also shows an inductive sensor 62 for detecting whether a tape is missing. A suitable signal or alarm can be activated to alert an operator to the absence of tape.

It may be necessary to slow the speed of the machinery when the tape is spliced, depending on the running speed of the machinery. Printing machines, which may use such dispensing units may run at about 4m/s (800ft/min), whereas currently splicing can only be performed at 2m/s (400ft/min). The motorised reel on the tape in use can be slowed to accommodate this change in speed; when the potentiometer senses that the tape on the reel is running low, i.e. the machine is about to perform splicing, the reel and therefore the tape can be driven at a lower speed. When the splicing action is completed the reel can again be driven at the usual speed.

Fig. 11 shows a schematic diagram a control system which can be utilised by the dispensing unit. Digital inputs relating to various information are fed into the programmable logic controller. The information can include, for example: whether the top or bottom tape has been selected (with a push-button); whether the end of the reel has been sensed with a inductive sensor 50; whether a reel of tape is missing, as sensed by a inductive sensor 62; or whether the nip rollers are in an open or closed configuration, as sensed by a reed switch

on a pneumatic actuator 33a, 33b. Analogue inputs such as those received by the inductive sensor shown in Fig. 9 or the potentiometers shown in Fig. 10 are also fed into the programmable logic controller. The controller can then control various activities of the dispensing machine. For example, when the voltage output by the potentiometers reaches a certain level corresponding to an almost empty reel the pneumatic actuators attached to the upper and lower portions of the splicing machine are activated to draw the nip cylinders on the upper and lower portions of the splicing unit together, so that splicing may take place. Furthermore, a signal may need to be sent to the pneumatic cylinder controlling the position of the clamp roller and the tape guide roller clamping a tape in the upper or lower clamp roller, so that the tape can be released in preparation for splicing. Similarly, a signal to turn off the vacuum on the upper or lower vacuum shoes, to prevent the vacuum from holding the leading edge of a reserve tape may need to be sent. A signal may also need to be sent to the upper or lower rotary cutter so that the upper or lower tape may be cut after splicing.

Accordingly, the detection of the amount of tape remaining on the reel can be performed automatically, and this information can be used to perform the splicing of the tape in use to the reserve tape automatically. However, these functions could also be performed manually.